Trauma Rounds

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Cardiac Injuries

EDWARD VERRIER, MD:* The case for presentation today is that of a 27-year-old black man who was brought to Mission Emergency Hospital unconscious. No history was available. On physical examination, the patient was somnolent, diaphoretic and had pinpoint pupils. Blood pressure was 80/40 mm of mercury and there was peripheral vasoconstriction. The neck veins were palpable but were not considered distended. Naloxone hydrochloride (Narcan®) was administered and immediately the patient became arousable and coherent. He then complained of abdominal pain and it was noted that a small, 1 cm high, epigastric stab wound was present. Lung fields were found to be clear bilaterally. There was a normal sinus rhythm and heart sounds were described as clear. The abdomen was soft and bowel sounds were present, but there was tenderness to palpation in the epigastrium beneath the stab wound.

Hematocrit was 41 percent, urine was clear on analysis and findings on an x-ray film of the chest were interpreted as essentially within normal limits with a slightly elevated left diaphragm. The cardiac silhouette was unremarkable.

A central line was placed. Central venous pressure was shown to be 37. Shortly thereafter vital signs deteriorated further and the pulse was barely palpable. Pericardiocentesis was attempted. This was productive of approximately 25 ml of nonclotting blood and there was some temporary improvement in circulatory function. Central venous pressure remained high and peripheral vasoconstriction was pronounced with a blood pressure of about 90 systolic.

The patient was taken to the operating room a short time later and under general anesthesia a left thoracotomy was carried out. Approximately 250 ml of clotted blood was evacuated from the pericardium. The patient had a small—0.5 cm—laceration of the right ventricle, which was sutured. Postoperatively the patient has done well and was discharged on the sixth day after operation.

DONALD D. TRUNKEY, MD:† *We are privileged today to have Dr. Paul Ebert, Professor and Chairman of the Department of Surgery at the University of California, San Francisco. Dr. Ebert, using this case as a starting point, would you discuss cardiac injuries?*

PAUL EBERT, MD:‡ This case makes some very interesting points. When the patient first arrived in the emergency department, hypotensive and in compensated shock, it was unclear what the exact cause was. The initial response to administration of naloxone hydrochloride was encouraging, yet he continued to remain in shock, and the epi-

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gastric stab wound was noted. This stresses the importance of a careful complete physical examination. It is well documented that slow blood loss into the pericardium may occur in such patients and the blood becomes defibrinated and puddles in the posterior pericardium. This may not have profound clinical effects immediately, but as the effusion and amount of blood increase the effects become obvious.

When one reviews trauma to the heart, there is a broad range of injuries to consider. Penetrating injuries can be fairly straightforward or insidious, such as the one that was presented today. When the laceration is small, tamponade may be minimal because the leak can seal, bleeding cease and the injury not be recognized. Another type of injury results when the blood loss is continuous but slow. The pericardium in these circumstances may accommodate quite a large volume before sudden decompensation occurs. The classic studies done by Dr. James Issacs have been repeated many times since. He infused increasing amounts of fluid into the pericardium of a dog and showed that up to a certain point there is no change in pressures in the right side of the heart. Then, with an addition of 5 to 10 ml, sudden decompensation occurs with pronounced impairment of venous return to the right side of heart. It is this last small amount that causes the dramatic changes in hemodynamic measurements.

It is the potential for a sudden change in hemodynamic status that can sometimes lead initially to misdiagnosis. Examination of the neck veins may show only slight distension. The patient may be hyperventilating and it may be difficult to differentiate between tension pneumothorax and pericardial tamponade. If pericardiocentesis is done, a small amount of fluid may be obtained and there may be dramatic improvement in the patient's condition. One can be misled into thinking that other resuscitative measures rather than aspiration of the small amount of fluid led to recovery. However, just a small drop in the filling pressures of the right atrium and ventricle may cause a dramatic increase in cardiac output.

The response to fluid resuscitation in itself may be misleading in determining tamponade. Patients in whom there have been massive lacerations of the heart usually die at the scene of the trauma. The patients who survive cardiac injuries are those in whom tamponade occurs and the rate of hemorrhage is slowed. When these patients are resuscitated in the emergency department, their conditions usually improve initially leading to the assumption that volume loss was a problem. The point I wish to make is that tamponade can often be a very difficult diagnosis to make based on clinical, radiographical and even angiographic findings. Clinicians simply must have a high index of suspicion when shock occurs secondary to a penetrating injury that may involve the chest.

DR. TRUNKEY: *Dr. Ebert, would you describe your method of doing pericardiocentesis?*

DR. EBERT: The best way to carry out this procedure is to insert the needle in the left subxiphoid area at an angle of 45 degrees, aiming for the left shoulder. I personally prefer to have the needle connected to the V lead of the electrocardiograph with an alligator clamp. As one advances the needle, a QRS complex is displayed on the electrocardiogram. When the needle touches the epicardial surface, the QRS immediately reverses polarity and becomes a giant complex. By using the electrocardiogram as a guide, the needle can be adjusted so as to avoid entering the ventricular cavity, thus assuring that any blood aspirated is from the pericardium and not from the ventricle. I prefer to use a plastic needle with an inner metal cannula. When one reaches the pericardial cavity, the inner cannula is withdrawn and the plastic needle can be left in place to evacuate as much blood as possible. Once the diagnosis has been made by aspiration, I personally prefer to take the patient to the operating room, carry out thoracotomy and correct the lesion. The expectant treatment of patients with pericardial tamponade leaves a lot to be desired since the condition of such patients can deteriorate suddenly as previously mentioned. Just a slight increase in the amount of fluid can cause an acute and dramatic fall in cardiac output, such as was shown in the case presented today. Repeat aspirations with needles run the risk of injury to the coronary circulation.

A PHYSICIAN: *What is the role of cardiopulmonary bypass in treatment of cardiac injuries?*

DR. EBERT: It is advantageous to have cardiopulmonary bypass available but the chances of needing it are not more than one out of every 25 injuries. The major thing that bypass offers is that it facilitates repair of a coronary artery, should this have been injured. Bypass can be instituted, the heart fibrillated and with a quiet field the

coronary artery can be easily repaired. It should be remembered that the patient survived coronary artery injury and reached the hospital. If the injury involves the distal half of the coronary artery and the patient is doing well, ligation rather than repair is simpler and perhaps safer.

DR. TRUNKEY: *Dr. Ebert, would you comment about blunt traumatic injuries?*

DR. EBERT: There seems to be an increasing incidence of blunt cardiac injuries; however, the diagnosis is usually missed. One should have a high index of suspicion for this when an injury such as that produced by a steering wheel has occurred. Myocardial injury can be documented by findings on an electrocardiogram and one may see changes similar to those of acute myocardial infarction. It is also possible to note pericardial tamponade, secondary to disruption of coronary or epicardial vessels. More frequently the heart simply is contused like the bruise of a thigh muscle. This is shown on the tracing by an injury pattern.

A PHYSICIAN: *What happens to patients with tamponade treated with pericardiocentesis only?*

DR. EBERT: In many instances, these patients do well. However, the risk of operation in this group is negligible and in some of these patients a constrictive type pericarditis may develop later. I operated on one patient a month and a half after cardiac injury and there was a fibrous peel completely enveloping the heart. If one chooses not to operate, the patient should be followed closely for development of constrictive pericarditis or postpericardiotomy syndrome.

A PHYSICIAN: *What is postpericardiotomy syndrome?*

DR. EBERT: This has been a special interest of mine. It appears that all patients who have postpericardiotomy syndrome will react immunologically to a myocardial membrane portion antigen. They also react to the spun-down membrane layer of streptococcus. This raises the question of whether the syndrome is due to the development of autoimmunity or infection. If one follows patients with postpericardiotomy syndrome, the syndrome may be suppressed with steroids but not the antibody. One may also find the same antibody in patients following myocardial infarction and, for lack of a better term, we call this antiheart antibody. I therefore think that the syndrome is really not a pericardial problem but possibly has its source in the myocardium.

A PHYSICIAN: *What about a patient who arrives* in extremis?

DR. EBERT: It is much easier to recommend the type of treatment to be used for such patients than for those with less dramatic clinical symptoms. The indications for treatment are clear and time is of the essence. I immediately would carry out a left thoracotomy in the fourth intercostal space—extending it, if needed, by incising one or two costal cartilages near the left sternal border. The pericardium is then opened in a longitudinal fashion, avoiding injury to the phrenic nerve. The clot is simply scooped out and the bleeding point located. Once this is done, a finger may be inserted into the injury site to control hemorrhage and the patient quickly taken to the operating suite. Here repair can be undertaken with optimal lighting, exposure and assistance. This operation is well tolerated, particularly by young patients, and wound complications are surprisingly low.

A PHYSICIAN: *How can you be sure that you are dealing with pericardial tamponade?*

DR. EBERT: Usually the clinical situation is fairly clear. The patient is in shock, as manifested by poor peripheral perfusion. The sine qua non in shock from tamponade is distended neck veins. When distended neck veins and shock are present, one should also consider tension pneumothorax. Usually these two can be differentiated by feeling for the trachea and determining whether it is the midline. Ancillary signs include percussion tympany and decreased breath sounds on the side of the lesion. A tension pneumothorax can be quickly relieved by inserting a chest tube in the second intercostal space on the suspected side. If the patient is *in extremis* and tamponade is suspected, thoracotomy is clearly indicated and will lead to decompression of any tension pneumothorax that is present.